

ON PERIODISATION

1. INDIAN STUDIES : PAST & PRESENT

The story of what Gordon Childe¹ describes as "the dramatic entry of India on the stage of Oriental history with the excavation of Harappa and Mohenjodaro", though well-known, may be briefly recapitulated. We follow B. K. Thapar² for the purpose.

In spite of "an undignified scramble for archaeological loot", the excavations undertaken during the latter half of the nineteenth century at Nineveh, Nimrud, Nippur and Lagash initiated the process of the dazzling revelation of the brilliance of the ancient Mesopotamian civilization.

Strangely enough, an equally ancient civilization of the Indus, with comparable environmental and economic pattern to that of Mesopotamia, had remained unrecognized and even unsuspected during these eventful years. And this despite the fact that the type-site, Harappa, had been extensively despoiled by brick robbing, and been excavated several times by Alexander Cunningham who had obtained various antiquities including a typical Indus seal (collected by a Major Clark), bearing pictographic characters. India thus continued to be referred to as a country where 'there was no twilight before dark'. It was not until 1921 and 1922 when preliminary trial diggings at Harappa by Daya Ram Sahni, and at Mohenjo-daro by R. D. Banerjee, had yielded identical finds, including exotic seals, that the potential of the sites came to be realized and the elements of a forgotten civilization identified. After examining the collection of antiquities from these two widely-separated sites and being convinced that they were totally distinct from anything previously known in India, Marshall announced the discovery in a London Weekly [in 1924]. This took the archaeological world by surprise, for the excavations at Ur by Leonard Woolley, almost during the same period, had already created a great sensation among Old World archaeologists. Writing elsewhere, Marshall had averred that 'the discoveries had at a single bound taken our knowledge of Indian civilization some 3000 years earlier'.

1. Childe NLMAE 2.

2. Thapar in FIC 1. This may be contrasted with the simplified statement of Lamberg-Karlovsky 189. "In 1921, Sir John Marshall excavated the major metropolises of the pre-aryan Indus civilization—Harappa and Mohenjo-daro."

What specially interests us for our present study may at once be noted. The excavation, in Childe's³ words, necessitated the admission that "India confronts Egypt and Babylonia by the third millennium with a thoroughly individual and independent civilization of her own, *technically the peer of the rest*". One result of the profound revolution in this knowledge of technology is the liberating influence it had for serious scholars from the earlier but somewhat obligatory limitation of accepting the Vedic literature as virtually the only source of information for the earliest chapter of the story of India's progress to civilization.

Vincent Smith's article⁴ in *Indian Antiquary*, "The Copper Age and Prehistoric Bronze Implements of India"—and even the contribution of John Marshall⁵ (then already the Director General of Archaeology in India) to the first volume of *The Cambridge History of India* (published in 1922) on "The Monuments of Ancient India"—show how desultory had then been the knowledge of Indian archaeology. In default of archaeological data, the scholars had recourse mainly to literary sources. The Vedic literature having been the earliest of these had to be taken as the starting point for understanding Indian history.

This explains the earlier tendency of trying to trace the beginnings of everything about Indian achievements to the Vedas. Understandably, technology and science were not exceptions to this. What, indeed, could the scholars do when nothing serious was known to them outside the Vedic literature as earliest available records of Indian achievements?

Examples of this are indeed numerous. It may be enough for our purpose to mention here only two.

I have before me a book containing over 350 pages by Binode Behari Dutt bearing the title *Town Planning in Ancient India*. The book was published in 1925, and was evidently written before anything substantial was known about the Indus Civilization. Though containing valuable information from later

3. Childe NLMAE 183. Emphasis added.

4. IA xxxiv. 229ff & xxxvi. 53ff. Vincent Smith remarks here that the history of India began with the Maurya, or still better with Alexander's invasion of India.

5. Marshall in CHI i. 612-648.

Indian architectural texts, the author also felt the need of discussing the origin of the technique in India. And he had then nowhere else to look for it than the Vedic sources. Hence he spoke of "The Vedic Origin of Town-planning", and remarked : "the Vedic Aryans had certainly developed a far more advanced knowledge in the science of building than a mere inchoate and crude sciolism. The plan of the towns and their denominations were identical with those of the geometrical figures that had to be, and are even now, drawn on the sacrificial altars. These figures suggested the plans and the names. It is sure that the Vedic civilization had long ago immensely outgrown the primitive stage and still glows with innumerable and irrefragable evidences of its high water-mark".⁶

If one discerns a spirit of patriotism in such an observation, it needs also to be added in the light of the new knowledge we have today that the patriotism is somewhat misplaced. Reserving for the present the question of the Vedic sacrificial altars and of their possible connection with house building—a question which we shall have to discuss later in some detail—it is relevant to mention here only one point. Town planning—and, for that matter, an amazingly advanced form of it—is actually witnessed by Indian history at a very ancient period. This was already over a thousand years before the making of the Vedas and the elaboration of the Vedic sacrificial cult connected with the fire altars.

In the first comprehensive report on the excavations at Mohenjo-daro and Harappa, Marshall⁷ observes, "Any one walking for the first time through Mohenjo-daro might fancy himself surrounded by the ruins of some present-day working town at Lancashire. That is the impression produced by the wide expanse of bare red-brick structures devoid of any semblance of ornament, and bearing in every feature the mark of stark utilitarianism. And the illusion is helped out, or rather the comparison is prompted, by the fact that the bricks themselves of which these buildings are composed are made much of a size with modern English bricks, but differ conspicuously from any during the historic period in India". Mackay adds,⁸

6. Dutt TPAI 7.

7. Marshall MIC 15.

8. Mackay EIC 18.

"and it is interesting to note that these ancient cities of the Indus plains are the earliest sites yet discovered where a scheme of town-planning existed. There is no evidence of such a scheme at Ur as late as 2000 B. C., though there are traces of one at Babylon at about that date ; and also at the Twelfth Dynasty town at Kahum in Egypt". In 1978, depending also on later archaeological work, S. P. Gupta and Shashi Asthana⁹ give us a more detailed idea of town-planning in the ancient Harappan civilization which we quote at some length :

From their foundation the cities of the Indus system appear to have been laid out in accordance with some pre-arranged scheme of things. It seems that building regulations were strictly enforced at Mohenjodaro, Kalibangan, Lothal and other places for many centuries and the greatest care were taken to prevent any structure from encroaching upon the roads and lanes. The major roads and lanes in the cities ran in straight lines and were crossed by others at right angles. The secondary streets were dog-legged. Within this planning it was seen by the planners that the major roads were aligned from east to west and from north to south, since the prevailing winds always came from the latter quarters. These roads had differing width, ranging from 30 feet to about 9 feet; which could accommodate several lines of wheeled traffic. The entire city was thus divided into a number of blocks arranged in a more or less chessboard pattern. One could easily reach the buildings of different blocks quickly and smoothly even on wheeled-carts...

The Harappan towns are well-known for their elaborate drainage system. Covered drains from the lanes discharged dirty water into the major drains which ultimately emptied it into tanks, jars, etc., or open areas outside the city. There are many other features both in town-planning and architectural devices.... which are well known and need not be detailed here.

S. R. Rao,¹⁰ writing for a popular journal, somewhat dramatically observes :

What is common between Mohenjo Daro and New York ? A glance at the road maps of the two cities reveals that the ancient metropolis was as well laid out as the modern one with roads running parallel in cardinal directions and crossed at right angles by streets leading to the individual buildings. And not just Mohenjo Daro, most Indus cities were as well planned—obviously one of the pointers of a highly evolved culture ... The orderliness and the consequent urban discipline of the Indus

9. S.P. Gupta and Sashi Asthana in ME ii. 47-8.

10. S. R. Rao in ST June 1982, 13-14.

civilization are reflected in its uniform system of weights and measures, in the planning of cities and the trade regulations which the Harappans were able to enforce throughout the vast empire. The municipal laws were strict. For instance, no encroachment was allowed on public streets. Over a period of four centuries (2300 B. C. and 1900 B. C.) the width of the Bazar street remained the same (4.5 metres) even though the flanking houses had to be reconstructed thrice due to heavy damage caused by floods. Similarly, inspection chambers in private drains were compulsory, so that solids could be removed before liquid waste entered the public drains... The Harappans were the first town planners of the world. In the earlier urban civilizations elsewhere such as the Sumerian, the cities were not planned; the streets of Ur, Kish and Brak were tortuously winding. The meticulous planning of the Harappans extended also to production, storage and distribution of food-grains as suggested by remains of the granaries seen at Harappa and Mohenjo Daro. The interlinking by river of towns in the interior with ports was another great advantage which ensured exchange of goods. For instance, the port at Lothal was connected by the Sabarmati with the north Gujarat hinterland. Harappa and Mohenjo Daro were interconnected by the Indus system, and so on.

We have quoted these to emphasise only one point. After the discovery of the Indus civilization, the history of town planning in India is certainly in need of being rewritten, as certainly again its starting point cannot be the Vedic literature.

I have also before me the well-known work by the late Radha Kumud Mookerjee on *Indian Shipping : A History of the Sea-borne Trade and Maritime Activity of the Indians from the Earliest Times*. For many years it was considered about the only full-length study of the subject attempted by the modern scholars, and its importance for the students of Indian history is generally admitted. Where, however, it reads strange today is about the maritime activity of the Indians of "the earliest times". Written in 1910 and first published in 1912, the author had nowhere else to look for it than the earliest literary sources available. Accordingly, he observes : "The oldest evidence on record is supplied by the *Rgveda*, which contains several references to sea voyages undertaken for commercial and other purposes".¹¹ In substantiation of this, Mookerji mentions five passages of the *Rgveda*, to which he could have added many more from the *Vedic Index* by

11. Mookerji 37. Following passages of the *Rgveda* are cited i. 25.7 ; i. 48.3 ; i. 56.2 ; i. 116. 3 ; vii. 88. 3-4.

Macdonell and Keith,¹² who argue against those that denied the Vedic people any actual knowledge of the sea.¹³

As for "sea-borne trade and maritime activity", however, there remained some problem. There are legends presumably coming down from a hoary antiquity and recorded in the *Jataka-s* indicating ancient Indian maritime trade with Mesopotamia. What could possibly be the basis of such legends? R. K. Mookerji¹⁴ observes :

The *Baveru Jataka* without doubt points to the existence of commercial intercourse between India and Babylon in pre-Asokan days. The full significance of this important *Jataka* is thus expressed by the late Professor Buhler : 'The now well-known *Baveru-Jataka* to which Professor Minayef first drew attention, narrates that Hindu merchants exported peacocks to Baveru. The identification of Baveru with Babiru or Babylon is not doubtful', and considering the 'age of the materials of the *Jatakas*, the story indicates that the Vanias of Western India undertook trading voyages to the shores of the Persian Gulf and of its rivers in the 5th, perhaps even in the 6th century B. C. just as in our days'.

Macdonell and Keith¹⁵ observe, "That there was any sea-trade with Babylon in Vedic times cannot be proved. There is, besides, little reason to assume an early date for the trade that no doubt developed later, perhaps about 700 B. C."

We have quoted these, because these are specimens of best scholarship on ancient Indian maritime activity that could be possible before the archaeological work of the last few decades. Indeed when the mental horizon of the historians could not be extended backward beyond the Vedic literature, the account of the maritime activity and sea-trade of the ancient Indians had to remain limited and circumscribed.

Today, however, the situation is quite changed. One has only to go through the brief paper on *Indus-Mesopotamian Trade* (1979) by Sashi Asthana¹⁶ or glance through some of

12. A. A. Macdonell and A. B. Keith ii. 432f.

13. Interestingly enough, it was A. B. Keith, who earlier doubted the knowledge of the sea on the part of the Vedic Aryans. Keith in CHI i. 79.

14. Mookerji 51.

15. A. A. Macdonell and A. B. Keith ii. 432.

16. Sashi Asthana, in EIP 31-43.

the writings on the subject by S. R. Rao and others to realise how profound are the changes in our knowledge of it, thanks mainly to recent archaeological work. We quote here only one observation¹⁷ on overseas trade of the ancient Indus period :

The sea-borne trade of the Bronze Age cities was unbelievably far-flung. As a predominantly-mercantile community the Lothal merchants sent their ships to distant ports in the Persian Gulf and even beyond. The excavations at Ras Shamra have revealed that ivory rods, now suspected to be of Indus workmanship, reached as far as the north Syrian coast. Archaeological evidence alone is sufficient to show that overseas trade was well-organized in the third millennium B.C. The merchants had established colonies outside their homeland and used specific types of seals prescribed by the local rulers or merchant guilds. For example, cylinder seals were brought into vogue in the Euphratis-Tigris valley, circular stamp seals in the Persian Gulf islands and square or rectangular stamp seals in the Indus Empire. It is thus possible to know the source of goods from the seals and seal-impressions recovered at different sites. The establishment of colonies of Indus merchants in the Bahrein islands, the Euphratis-Tigris valley and the Diyala region is attested to by the seals bearing Indus motifs and script found at Ras-al-Qala, Ur, Kish Asmar and the Diyala sites. Other evidences of trade between the Indus and Sumerian cities are provided by Indus weights and beads in south Mesopotamia and gold beads and painted pottery of Mesopotamian origin at Lothal and other Harappan sites.

We shall see more of overseas trade later.¹⁸ For the present the point is that in the light of the new knowledge we have

17. S. R. Rao LIC 111.

18. S. R. Rao, "Shipping and Maritime Trade of the Indus People" in *Expedition* Vol. 7, No. 3. Philadelphia 1965, S. R. Rao, "Shipping in Ancient India, India's contribution to World thought and culture," Madras : 1970, 89-107 ; Mallowan, "The Mechanism of Ancient Trade in Western Asia", *Iraq*, Vol. III (1965). pp. 1-7 ; D. K. Chakrabarti, "The external trade during Harappan period : evidence and hypothesis", in *50 years of Harappan Discovery*, ed. B. B. Lal and S. P. Gupta (in press) ; D. K. Chakrabarti, "Gujrat Harappan connection with West Africa : A reconstruction of the evidence" in *JESHO* 18, 3 337-42 ; E.C.L. During-Caspers, "Harappan trade in the Arabina Gulf in third millenium B.C." in *Mesopotamia* VII. (1972) 167-191 ;—'Etched carnelian beads' in *Bulletin of the Institute of Archaeology* X. (1972). 83-98 ;—'New Archaeological Evidence for maritime trade in the Persian Gulf during the late Proto-literate Period' in *EW* Vol. 21-(1-2). 1971

today, what is earlier viewed about maritime trade—like that of town planning—is certainly in need of being rewritten, as certainly again its starting point is not the Vedic literature.

2. VEDA-CENTRISM AND INDIAN HISTORY

But let us first be clear about one point. What we are trying to emphasise here is not the mere fact of the accumulation of greater information about the earlier period of Indian history resulting from the archaeological work. What we want to emphasise instead is the *profound change in the very orientation of Indian studies* and this mainly because of the excavations of Harappa, Mohenjo-daro and other sites of the ancient Indus civilization. For the purpose of a proper appreciation of this, we begin with a few words on the limitations of the earlier approach.

The Indian tradition strongly insists that the Vedic literature is essentially religious. So also are the other literatures of India seriously studied by the earlier generation of Indian historians. The result has been the periodisation of Indian history mainly in religious terms.

This is easily seen from the first volume of *The Cambridge History of India*, which for many years virtually remained the model sketching of ancient Indian history. Here are some of its prominent chapter headings: "The Age of the *Rgveda*", "The Period of the later Samhitas, the Brahmanas, the Aranyakas and the Upanishads", "The History of the Jainas", "The Early History of the Buddhists"—and so on, until the historians felt somewhat relieved of being obsessed by religious

21-44;—"Sumer, coastal Arabia and the Indus Valley in proto-literate and Early Dynastic eras. Supporting evidence for a cultural linkage in JESHO 22,2 (1979). 121-35; S. Parpola, A. Parpola and R. H. Brunswig, Jr. "The Meluha village: evidence of acculturation of Harappan traders in late 3rd millenium Mesopotamia" in JESHO 20,2 (1977). 129-65; S. R. Rao, LIC 114 ff. S. Ratnagar, "Long distance trade of the Harappan civilization" in "50 years of Harappan discovery," eds. B. B. Lal and S. P. Gupta (in Press); I. J. Gelb, "Makkan and Meluha in Early Mesopotamian Sources" *Revue d'Assyriologie* 64 (1970). 1-8; S. N. Kramer, "The Indus civilization and Dilmun, the Sumerian Paradise land", in *Expedition* 6. No.3 (1964) 44-52.

preoccupation when they reached the age of the Mauryas or of the Persian domination of northern India, and, above all the time of Alexander's invasion.

This religious bias apart, what then influenced the understanding of ancient Indian history was some kind of a racial bias, tacit though it might have been. This was also, at least to a considerable extent, the result of accepting the Vedas as the only valid starting point of Indian studies. Those who composed the Vedas called themselves the *arya-s* or Aryans, literally "the nobles". The language of this literature, as was first shown by the famous address of William Jones in 1786, was closely connected with the languages of the Persians, Greeks, Romans, Celts, Germans and Slavs. It was thus thought that all these developed out of some root-language, for which the term often used was Indo-European. "But the study of this family of languages has from the beginning been beset with a subtle fallacy. There has been throughout an almost constant confusion between the languages and the persons who spoke them."¹⁹ Thus came into being the theory of the Aryans—or of the Indo-Aryans—who gave to Indian culture the Vedic literature. Ancient Indian history was accordingly conceived largely in terms of the colonization of India by the invading Aryans. The Aryans, it was assumed, brought civilization to the local peoples, the most prominent of whom—largely on linguistic considerations again—were called the Dravidians. How far such a model of ancient Indian history also suited the general temper of the European colonisers is a different question, into which we need not at present digress. In fairness, however, it must be admitted that some of the European scholars were in the forefront in breaking away from this understanding of ancient Indian history, while some of the Indian scholars still remain consciously or unconsciously exposed to its influence.²⁰

What concerns our present discussion is to note how the archaeologists' spade shattered this earlier model of ancient

19. P. Giles in CHI i. 64-65.

20. Even a scientist like Meghnad Saha, as already noted, had to enter into a prolonged controversy with the traditionalists claiming that practically everything worthwhile in contemporary science was already known to the Vedic Aryans. See Chapter 1.

Indian history. The discovery of Harappa and Mohenjo-daro, in other words, had for the serious scholars a liberating effect from the dual limitations of the earlier understanding, inasmuch as—following what was firmly argued by R. P. Chanda,²¹ B. S. Guha²² and others²³—the builders of the Indus civilization were viewed as pre-Aryans and non-Aryans. This is a point on which the later archaeologists are on the whole agreed. T. N. Ramachandran²⁴ and some others²⁵ have, of course, a dissenting note to this, for they are inclined to think that the Vedic Aryans were themselves the builders of the Indus civilization. Before putting too much confidence on their view, the readers may as well go through K. C. Chattopadhyaya's *Studies in Vedic and Indo-Iranian Religion and Literature*²⁶ : practically everything decisive that needs to be said from the viewpoint of Vedic scholarship against the possible Vedic origin of the Indus Civilization is already said in this.

3. ARCHAEOLOGY : NEW LIGHT ON ANCIENT INDIA

We shall quote here only two examples of the first flush of enthusiasm created for the reinterpretation of ancient Indian culture by the excavations of Harappa and Mohenjo-daro. One of these is concerning the new way of looking at Hindu religion, often considered as the basic plank of Indian culture. The other is more immediately relevant for the main theme of our present discussion, because it indicates the possibility of tracing the roots of classical Indian science to the achievements of the Indus period.

In his first comprehensive report *Mohenjo-daro and the Indus Civilization*, published in 1931, Marshall wrote a longish chapter on the religion of the Indus civilization. Though written about five decades back the chapter is still considered

21. R. P. Chanda, in MA SI No. 31.

22. B. S. Guha, in Marshall's MIC ii. chap. xxx, 599-644.

23. Childe NLMAE 185.

24. T. N. Ramachandran, *Presidential Address, Section I Indian History Congress*, xix session, Agra : 1956, 1-14.

25. B. K. Chattopadhyaya, "Mohenjo-daro Civilization" in CR vol. 139 : 121-6 ; vol. 141 : 252-60 ; vol. 144 : 127-33.

26. K. C. Chattopadhyaya, SVIIRL ii. 40-50. cf. also R. S. Sharma in MCSFAI 171.

"brilliant"²⁷ by some the leading archaeologists of our time. Marshall²⁸ observes :

Many of the basic features of Hinduism are not traceable to an Indo-Aryan source at all. They come into view, not in the earliest Vedic literature, which represents the more or less pure Indo-Aryan tradition, but either in the later Vedas or in the still later *Brahmanas*, Upanishads and Epics, when the Vedic Aryans had long since amalgamated with the older races and absorbed some measure of their culture and teachings.... Whence these various elements were derived and when they found their way into the fabric of the national religion has never yet been satisfactorily explained.... A few of these features, it has been conceded, may have been taken over from the pre-Aryans, but only such primitive ones as the worship of trees and animals and stones, which are common to the majority of uncivilized races. Those who have championed this view (and they include the chief writers on the subject) knew little, of course, of the great pre-Aryan civilization that has now been revealed. They pictured the pre-Aryans as nothing more than untutored savages, whom it would have been grotesque to credit with any reasoned scheme of religion or philosophy. Now that our knowledge of them has been revolutionized and we are constrained to recognize them as no less highly civilized—in some respect, indeed, more highly civilized—than the contemporary Sumerians or Egyptians, it behoves us to redraw the picture afresh and revise existing misconceptions regarding their religion as well as their material culture..... In view of these facts, is it not reasonable to presume that the peoples who contributed so much to the cultural and material side of Hinduism, contributed also some of the essential metaphysical and theological ideas so intimately associated with it ?

Gordon Childe seems to go a step further and expect new light to be eventually thrown by this archaeological discovery even on the possible indebtedness of occidental science to the scientific achievements in the ancient Indus civilization. The Indus script, which survives for us mainly on the "seals", argues Childe on Sumerian and Cretan analogies, could have been primarily devised for documents of accounts keeping, though such documents must "have perished with the unknown

27. B. & R. Allchin, RCIP 213.

28. Marshall MIC 77-78. Childe NLMAE 185 sums up Marshall's observations on the religion of the Indus, and adds : "for the above reasons alone the Indus civilization will be regarded as non-Aryan and pre-Aryan"

material on which they were written".²⁹ Referring to this script, he observes³⁰ :

With this equipment the Bronze Age citizens of the Indus valley could have—and, indeed, must have—developed exact science as well as Sumerians and Egyptians, and for the same imperious reasons. For instance, a free use in decorative art of squares inscribed in compass-drawn intersecting circles suggests a study of geometry. But the results of such sciences are not directly known....

The imposing civilization perished utterly as a result of internal decay accelerated by the shock of barbarian raids. Only since 1920 have its dumb outlines been rescued from complete oblivion by archaeologists....

Nevertheless, since Indus manufactures were imported into Sumer and Akkad, and Indus cults were actually celebrated there, the forgotten civilization must have made direct if undefinable contributions to the cultural tradition we inherit through Mesopotamia. Moreover, the technical traditions of the Bronze Age craftsmen, at least of potters and wainwrights, persist locally until today. Fashions of dress, established in the Indus cities, are still observed in contemporary India. Hindu rituals and deities have roots in the cults depicted in the prehistoric art. *So classical Hindu science, too, and through it occidental science, may be indebted to the prehistoric to an unexpected degree.* From this standpoint the Bronze Age civilization of India has not utterly perished; 'for its work continueth far beyond our knowledge.'

4. LATER ARCHAEOLOGICAL WORK AND LITERATURE

The observations just quoted were published decades back—that of Marshall in 1931 and of Childe in 1942. Since then considerable archaeological work is being done on the cultural frontiers of ancient India, inclusive of significant work done by archaeologists in Pakistan since 1947. Though still considered inadequate in certain respects (specially as restricted mainly to vertical excavations)—and though the delay in publishing the reports on works already done is often regretted—an enormous amount of new materials is available today. Apart from what is known from the better explorations and excavations of the early stone age sites, we now have extensive information about the pre-Harappan, Harappan and post-Harappan settlements in the broader Indus region, about the Neolithic-Chalcolithic

29. Childe WHH 128.

30. *Ibid* 128-129. Emphasis added.

settlements beyond the Indus system, and about the iron age and early historical sites.

So also we have before us a very imposing literature on the subject. What is written on the Harappan Culture alone, as evidenced by the *Bibliography*³¹ prepared by B. M. Pande and K. S. Ramachandran and published in 1971, is quite substantial. But this is only one example of the literature being stimulated by recent archaeological work on the cultural frontiers of ancient India and it is already somewhat dated. Besides, excavations and explorations are going on, adding to the volumes of the reports on these.

The vast literature, it needs to be noted, does not necessarily restrict itself to what is sometimes called cold archaeological data. All sorts of questions are also raised in these writings concerning the possible deductions from such data. In answering these questions, the writers—inclusive of very eminent archaeologists—are actually far from being unanimous. There are often sharp controversies on extremely vital issues among scholars, none of whose authority it is easy to dismiss. Thus, for example, the archaeologists are yet far from being agreed on the origin and formation of the Harappan civilization, the nature of the socio-political organization and intellectual climate in it, the cause of decline, degeneration and end of the civilization, of its legacy in later Indian culture, and so on, though thanks to the advent of the technique of radio-carbon dating the chronological controversies are now on the whole abated, notwithstanding the storm still going on about relating the archaeological data with literary evidences.

In such circumstances, any tendency to accept or reject the earlier observations of Marshall and others without taking note of the later archaeological literature is liable to be oversimplified. But so also would be the hope of following some safer course, steering clear of the recent controversies, inclusive of those with which the names of eminent archaeologists are associated. Lest, however, we get lost into the maze of all

31. B. M. Pande, and K. S. Ramachandran BHC. D. K. Chakrabarti in *Puratattva* No. 6 (1972-73) p. 97-98 reviews it, pointing to some lapses and errors in it. It may be added that the bibliography given at the end of Possehl's ACI contains 1607 entries.

these, it is necessary for us first of all to be clear about the exact scope of our present discussion and of the special relevance for it of archaeological evidences.

5. ARCHAEOLOGY AND ANCIENT TECHNOLOGY

Our purpose is not to survey Indian archaeology in the sense in which it is done by many eminent scholars, both in India and abroad. But we are obliged to begin with some account of recent archaeological researches because of a number of important considerations. We shall mention here a few of these.

One reason for beginning with archaeology is quite on the surface. Any attempt to understand technology specially of the ancient period without depending on the archaeologists is just absurd. For the pre-historic and proto-historic periods, archaeology—and archaeology alone—provides us with the surest information about technology and its development. In the contexts in which very ancient literary sources are also available—as in the case of India where we have the extensive Vedic literature—the material relics of extinct societies often prove to be of surprising significance for interpreting certain archaic words and passages than the method of pure philological analysis, though of course the literary sources in their turn may sometimes be of much help to the archaeologists for understanding their data. But the question of co-relating archaeology with literature is a very complex one and let us not digress into it for the present.

Instead of that, we may briefly mention here another point, namely that of the relation of technology with science. The difficulties about defining science are, of course, well known. J. D. Bernal questions the very possibility of cramping science into any neat definition: "Science is so old, it has undergone so many changes in its history, it is so linked at every point with other social activities, that any attempted definition, and there have been many, can only express more or less inadequately one of the aspects, often a minor one, that it has had at some period of its growth".³² It will be observed no doubt that even such an observation has to presuppose some basic understanding of science. What is it that is so old and that

has undergone so many changes in history that it frustrates the very possibility of a clear-cut definition? In other words, in default of any exact definition of science, a study in its history cannot but begin—tacitly at any rate—with some understanding of it.

The basic understanding of science which Bernal himself has in mind is not difficult to judge. He speaks of “the generalised techniques from which science arose and to which it is still attached”.³³ Science, he observes, “does not appear in the first place in a recognizable form. . . . It is necessary to search for its hidden sources in the histories of human arts and institutions”.³⁴ “The tool-using and fire-using animal is well on the way to scientific humanity. Just as the tool is the basis of physical and mechanical science, so is fire the basis of chemical science”.³⁵ “It was in the ways of extracting and fashioning materials so that they could be used as tools to satisfy the prime needs of man that first techniques and then science arose. A technique is an individually acquired and socially secured way of doing something; a science is a way of understanding how to do it in order to do it better. When we come to examine in greater detail. . . the first appearance of distinct sciences and the stages of their development it will become increasingly plain that they evolve and grow only when they are in close and living contact with the mechanism of production”.³⁶

More quotations are not necessary. It is already obvious that in Bernal's understanding at any rate any attempt to view science without relating it to technology will be fallacious. This becomes increasingly obvious as we move backward to human history. Not that this means that we may equate science to technology. What it means, however, is that science cannot be viewed as a purely disinterested search for truth or the product of pure reason, as it was and is being still viewed by many. On the contrary, the assumption on the basis of which we propose to work—an assumption endorsed by Joseph Needham, Benjamin Farrington, Gordon Childe, George Thomson and

33. *Ibid* 49.

34. *Ibid* 61.

35. *Ibid* 70.

36. *Ibid* 47.

many others, in whose writings the history of science has become sufficiently scientific—is that science is *implicit* in technology and hence can at best be very inadequately understood—if not positively misunderstood—without the broader perspective of technology. This is the second major justification for beginning with archaeology, for, as already observed, archaeology provides us with the most dependable information about technology of the ancient period.

6. PROBLEM OF PERIODISATION REOPENED

But there is another consideration that leads us to begin with archaeology specially in the Indian context. The importance of this consideration can hardly be exaggerated. Archaeological work on the cultural frontiers of ancient India during roughly the last six decades has in fact thoroughly revolutionized the mode of periodising ancient Indian history.

We have already noted how the discovery of Mohenjo-daro and Harappa has relieved the serious scholars from the earlier but somewhat necessary obligation of beginning with the Vedic literature as virtually the only starting point for understanding the earliest chapter of India's progress to civilization. But the implications of the recent archaeological works are much more profound than this.

The discovery of the Harappan civilization took place in the third decade of our century. Since then the archaeologists have worked not merely on the frontiers of the Indus civilization but have excavated and explored—as they are still doing—very large areas of India, and of course also of areas beyond the present political boundaries of India. Spectacular results are often reached by them, of which we shall mention here only those that have direct bearings on the periodisation of ancient Indian history.

Notwithstanding the debate still going on about the origin of the Harappan civilization, the archaeologists are fully agreed that, judged specially in the ancient context, it was a very advanced form of civilization, embracing within its orbit a number of significant urban centres like Mohenjo-daro, Harappa, Kalibangan and Lothal. In short, there is no scope to doubt that the Harappan civilization was a highly urban one; it is in fact for us the evidence of First Urbanization so far known about ancient Indian history.

How exactly it came to its "end" is, of course, a very thorny question. There is literally a wilderness of conjectures concerning the cause of its decline and eventual destruction—ranging from malarial epidemic to the shock of Aryan attack. There are also controversies on the question whether the "end" of the Harappan civilization was a total one, leaving no trace of it whatsoever in later Indian culture. We shall have to return to some of these questions because of their obvious bearing on the main subject of our discussion. For the present the point is that after a flourishing period of many centuries, the civilization did come to an "end" and—thanks to the advent of radio-carbon dating—at least the majority of serious archaeologists are now agreed to accept the date of this event roughly as 1750 B.C.

Our question naturally is : What happened in Indian history specially in northern India after the decline or destruction of the Harappan civilization? In 1942, Gordon Childe has observed, "In Egypt, Mesopotamia and India, eras of prosperity that have left a vivid impression in the archaeological record were succeeded by Dark Ages from which few buildings and inscriptions survive. *In India civilization itself seems to have been extinguished*".³⁷

We are concerned here with what happened in India. After the end of the first urbanization, it took a period of about a thousand years or more for civilization in its true sense to take shape or for the reintroduction of urban life. It is the usual practice of the archaeologists to refer to this reintroduction of urban life as indicative of the period of Second Urbanization. The period intervening the two urbanizations—which from the archaeological point of view is often called the "Dark Age" or the "Dark Period"—persisted for a thousand years or more.

We shall have to see what archaeology has to tell us about this intervening period between the two urbanizations. We shall also have to see what data other than the archaeological ones we have that throw light on this period. For the present, the point is that mainly as the result of the archaeological work of about the last six decades, our understanding of the periodisation of ancient Indian history is—or requires to be—basically changed. We can better understand it if divided into

37. Childe WHH 151. Emphasis added.

three main periods, namely those of 1) the First Urbanization, (2) an intervening "Dark Period" and (3) the Second Urbanization.

7. TWO URBANIZATIONS AND "THE DARK AGE"

Thus in Indian history, we do not have the story of a unilinear process of urbanization beginning in some hoary antiquity and continuing down to a much later period, which is usually characterised as the "historical" one. What we have instead are two distinct processes of urbanization with a period of over a thousand years intervening between the end of the former and the beginnings of the latter.

But what is meant by "the two urbanizations"? What happened during the period intervening the two? These, we are going to see, are questions crucial for our understanding of the history of technology and science in ancient India. We begin with brief descriptive answers to these.

Of the two urbanizations, only the first answers to what Gordon Childe calls the "urban revolution". This, as we shall presently see, is in his view a precondition for the making of mathematics and astronomy as "exact and predictive" sciences.

In the archaeologists' view, this is exemplified by the Indus valley civilization, for which some of the recent writers prefer to use the expression Harappan Culture or Mature Harappan Culture—Harappa being taken as the typesite of this culture, which extended far beyond geographical borders of the Indus Valley.³⁸

Earlier archaeologists like Marshall and others tried to estimate its date, depending mainly on evidences that may be called circumstantial. In recent years, however, it has become possible to be fairly certain about it. As the Allchins³⁹ observe :

The advent of radiocarbon dating has provided a welcome new source of information on what must otherwise have remained a very vague position, and may well necessitate a revision of the earlier views.

38. See, M. R. Mughal, in Possehl's ACI 91 and B. K. Thapar in FIC 1 ff. for these terminological differences. Such differences, however, are not considered essential for our own discussion and hence are used interchangeably.

39. B. & R. Allchin RCIP 218.

By 1956 Fairservis had seen in the (as yet uncalibrated) radiocarbon dates of his excavations at Quetta valley a need to bring down the dating of the Harappan culture to between 2000 and 1500 B.C. In 1964 D. P. Agrawal, of the radiocarbon laboratory attached to the Tata Institute of Fundamental Research in Bombay, was able to plot some two dozen dates, including those for Kot Diji, Kalibangan and Lothal, and to draw the conclusion that the total span of the culture should be between 2300 and 1750 B.C. (based on uncalibrated dates). This evidence still appears to be most plausible.

We may be yet far from being certain about the actual cause of the final decline or destruction of the Harappan cities. Whatever it had been, however, there are grounds to think that this took place sometimes near 1750 B.C. We have thus an idea of the time when the First Urbanization in ancient India came to its end.

And what, approximately, is the date of the beginnings of the Second Urbanization? We quote A. Ghosh,⁴⁰ to whom we owe an important monograph on the subject: "For her next cities, her 'second urbanization', India had to wait for over a thousand years after the disappearance of the Indus cities—till the middle of the sixth century B.C., which saw simultaneously the beginnings of her historical period."

And how do the archaeologists want us to view the period intervening the two urbanizations? Subbarao⁴¹ says, it "is dramatically called the Dark Period". B. B. Lal⁴² also speaks of "the Dark Age between the end of the Indus civilization and the beginning of the early historical period."

Following this practice of the archaeologists, therefore, we may sum up the periodisation of ancient Indian history as follows, though adding that the scene of this was confined mainly to northern India:

- (a) Period culminating in First Urbanization as evidenced by the Mature Harappan Culture, which came to its end sometime near 1750 B.C.
- (b) A Dark Period or Dark Age of over a thousand years following the end of the First Urbanization.

40. A. Ghosh, CEHI 2.

41. B. Subbarao, 100.

42. B. B. Lal, in CF 22.

(c) Period of Second Urbanization, first foreshadowed roughly in the sixth century B.C. and leading eventually to the formation of the early historical cities.

Before passing on to further discussion, we may have a brief note on the second of these three. The archaeologists called this the Dark Period or the Dark Age, because nothing substantial was known about it even a few decades back. Thanks to the brisk field-work of the Indian archaeologists in recent years, however, we have ampler information about this period than we had even at the time of Indian independence.

But, in spite of this, specially from the viewpoint of technology and science, the period continues to be "dark" after all. It was—as compared to the highly urban achievements of the ancient Indus cities—a period of reverting again to the stage of pre-literate peasant communities. The technique of writing—or, more strictly, of the use of script—which is an important trait of the First Urbanization—is lost during this intervening period, notwithstanding the attempt to see in the graffiti marks on the pottery of Rangpur some kind of survival of the Indus scripts.⁴³ The technique of using kiln-burnt bricks for construction of houses and other monumental structures in the Indus cities is totally forgotten and, in the intervening period, we come across only humble habitations made of mud or mud-bricks. And so on.⁴⁴ Archaeologically, the main index to this period is a pottery type, known as the Painted Grey Ware.⁴⁵

43. S. R. Rao, in *AI* Nos. 18-19. 1963, 5-207. See also, A. Ghosh *CEHI* 75, and B. B. Lal in *AI* No. 16, 4-24.

44. But all this, as we shall see later, does not substantiate A. Ghosh's thesis *CEHI* 73ff of the complete and absolute extinction of the Harappan culture in Indian history. In spite of the intervening dark age, later Indian culture is characterised by strong and important survivals of the Harappan culture.

45. About 700 PGW sites are located so far mainly in the region associated with Vedic settlements and there is the general tendency among the scholars to associate this pottery with the Vedic people. But R. S. Sharma in *MCSFAI* 57 wants us to note the following—"However there is nothing like an exclusive PGW culture because other wares such as black-and-red ware, black-slipped ware, red ware and plain grey ware are also associated with them. Although very distinctive, the PGW sherds are not numerically predominant at any place. At Atranjikhhera, where the PGW covers an area of about 650 sq. m., its incidence ranges between three and ten per

Though as pottery it is considered very fine, its sites are not indicative of advanced material culture. In this context of practically all-round technological regression, it is evidently useless to expect much of scientific activities, outside perhaps certain formal disciplines arising from the technique of orally transmitting a vast literature.

The evidence of this "dark age" intervening the periods of two urbanizations is important for our understanding of the history of technology and science in ancient India, because it is this that defines the chronological horizon within which we are to place all that could have been the distinct contributions of the Indo-European speaking peoples who called themselves the Aryans and who gave to Indian culture a vast body of orally composed songs and hymns that were eventually compiled in the form of the *Rgveda-samhita*. We shall later see that it is impermissible to imagine these people entering the Indian subcontinent much before the end of the First Urbanization. Nor is it permissible to imagine that these people could have retained much of their original identity towards the beginnings of the process of Second Urbanization, because by this time they got inextricably mixed up with the local peoples among whom they advanced, adapting and thriving mainly on the material culture that had locally developed. As Ghosh⁴⁷ puts it, "In short, the early Aryan society had made room for the Indian Society, in which it is difficult to isolate Aryan and non-Aryan elements." Thus whatever could have been distinctive of the contributions of these Aryans is to be sought in the period intervening the two urbanizations. For the main subject of our study, all these warn us against the extravagant enthusiasm of some of our scholars to read in the Vedas a great deal of achievement in science and technology. But more of this later.

cent of the total pottery complex. Even where their number is fairly large, the PGW sherds may not exceed fifteen per cent of the total pottery recovered from the PGW layers. Thus the PGW horizon represents a composite culture, just as the culture revealed by the later Vedic texts represents an amalgam of Sanskritic and non Sanskritic, Aryan and non-Aryan elements."

46. This is corroborated by the internal evidences of the *Rgveda*. For example, RV. I. 38. 14.

47. A. Ghosh, CEHI 4.